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On new TREE FERNS and other FOSSILS from the DEVONIAN. By
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[PLATE XII.]

OF the numerous ferns now known in the Middle and Upper Devonian of North America, a great number are small and delicate species, which were probably herbaceous; but there are other species which may have been tree ferns. Little definite information, however, has, until recently, been obtained with regard to their habit of growth.

The only species known to me in the Devonian of Europe is the *Caulopteris Peachii* of Salter, figured in the Quarterly Journal of the Geological Society for 1858. The original specimen of this I had an opportunity of seeing in London, through the kindness of Mr. Etheridge, and have no doubt that it is the stem of a small arborescent fern, allied to the genus *Caulopteris* of the Coal-formation.

In my paper on the Devonian of Eastern America (Quart. Journ. Geol. Society, 1862) I mentioned a plant found by Mr. Richardson at Perry, as possibly a species of *Megaphyton*, using that term to denote those stems of tree ferns which have the leaf-scars in two vertical series; but the specimen was obscure, and I have not yet obtained any other.

More recently, in 1869, Prof. Hall placed in my hands an interesting collection from Gilboa, New York, and Madison County, New York, including two trunks surrounded by aerial roots, which I have described as *Psaronius textilis* and *P. erianus* in my 'Revision of the Devonian Flora,' now in the hands of the Royal Society*. In the same collection were two very large petioles, *Rhachiopteris gigantea* and *R. palmata*, which I have suggested may have belonged to tree ferns.

My determination of the species of *Psaronius*, above mentioned, has recently been completely confirmed by the discovery on the part of Mr. Lockwood, of Gilboa, of the upper part of one of these stems, with its leaf-scars preserved and petioles attached, and also by some remarkable specimens obtained by Prof. Newberry, of New York, from the Corniferous Limestone of Ohio, which indicate the existence there of three species of tree ferns, one of them with aerial roots similar to those of the Gilboa specimens. The whole of these specimens Dr. Newberry has kindly allowed me to examine, and has permitted me to describe the Gilboa specimen, as connected with those which I formerly studied in Prof. Hall's collections. The specimens from Ohio he has himself named, but allows me to notice them here by way of comparison with the others. I shall add some notes on specimens found with the Gilboa ferns, and on a remarkable plant from the Devonian of Caithness, kindly placed in my hands by Dr. Wyville Thomson.

It may be further observed that the Gilboa specimens are from a bed containing erect stumps of tree ferns, in the Chemung group

* Abstract in Proceedings of Royal Society, May 1870.

of the Upper Devonian, while those from Ohio are from a marine limestone, belonging to the lower part of the Middle Devonian.

1. *CAULOPTERIS LOCKWOODI*, n. sp.

(Plate XII. figs. 1 to 3.)

Trunk from two to three inches in diameter, rugose longitudinally. Leaf-scars broad, rounded above, and radiatingly rugose, with an irregular scar below, arranged spirally in about five ranks; vascular bundles not distinctly preserved. Petioles slender, much expanded at the base, dividing at first in a pinnate manner, and afterwards dichotomously. Ultimate pinnæ with remains of numerous, apparently narrow pinnules.

This stem is probably the upper part of one or other of the species of *Psaronius* found in the same bed (*P. erianus*, Dawson, MS.; and *P. textilis*, Dawson, MS.*). It appears to have been an erect stem imbedded *in situ* in sandstone, and preserved as a cast. The stem is small, being only two inches, or a little more, in diameter. It is coarsely wrinkled longitudinally, and covered with large leaf-scars (fig. 2) each an inch in diameter, of a horseshoe-shape. The petioles, five of which remain, separate from these scars with a distinct articulation, except at one point near the base, where probably a bundle or bundles of vessels passed into the petiole. They retain their form at the attachment to the stem, but a little distance from it they are flattened. They are inflated at the base, and somewhat rapidly diminish in size. The leaf-scars vary in form, and are not very distinct, but they appear to present a semicircular row of pits above, largest in the middle. From these there proceed downward a series of irregular furrows, converging to a second and more obscure semicircle of pits, within or below which is the irregular scar or break above referred to. The attitude and form of the petioles will be seen from fig. 1.

The petioles are broken off within a few inches of the stem; but other fragments found in the same beds appear to show their continuation, and some remains of their foliage. One specimen shows a series of processes at the sides, which seem to be the remains of small pinnæ, or possibly of spines on the margin of the petiole. Other fragments show the division of the frond, at first in a pinnate manner, and subsequently by bifurcation; and some fragments show remains of pinnules, possibly of fertile pinnules. These are very indistinct, but would seem to show that the plant approached, in the form of its fronds and the arrangement of its fructification, to the Cyclopterids of the subgenus *Aneimites*, one of which (*Aneimites acadica*), from the Lower Carboniferous of Nova Scotia, I have elsewhere described as probably a tree fern†. The fronds were evidently different from those of *Archæo-*

* Memoir on Devonian Flora, Proceedings of Royal Society, May 1870.

† Quart. Journ. Geol. Society, 1860.

*pteris**, a genus characteristic of the same beds, but of very different habit of growth. This accords with the fact that there is in Prof. Hall's collection a mass of fronds of *Cyclopteris* (*Archæopteris*) *Jacksoni*, so arranged as to make it probable that the plant was an herbaceous fern, producing tufts of fronds on short stems in the ordinary way. The obscurity of the leaf-scars may render it doubtful whether the plant above described should be placed in the genus *Caulopteris* or in *Stemmatopteris*; but it appears most nearly allied to the former. The genus is at present of course a provisional one; but I think it only justice to the diligent and successful labours of Mr. Lockwood to name this curious and interesting fossil *Caulopteris Lockwoodi*.

I have elsewhere remarked on the fact that trunks, and petioles, and pinnules of ferns are curiously dissociated in the Devonian beds—an effect of water-sorting, characteristic of a period in which the conditions of deposition were so varied. Another example of this is, that in the sandstones of Gaspé Bay, which have not as yet afforded any example of fronds of ferns, there are compressed trunks, which Mr. Lockwood's specimens allow me at least to conjecture may have belonged to tree ferns, although none of them are sufficiently perfect for description.

Mr. Lockwood's collection includes specimens of *Psaronius textilis*; and in addition to these there are remains of erect stems somewhat different in character, yet possibly belonging to the higher parts of the same species of tree fern. One of these is a stem crushed in such a manner that it does not exhibit its form with any distinctness, but surrounded by smooth cylindrical roots, radiating from it in bundles, proceeding at first horizontally, and then curving downward, and sometimes terminating in rounded ends. They resemble in form and size the aerial roots of *Psaronius erianus*; and I believe them to be similar roots from a higher part of the stem, and some of them young and not prolonged sufficiently far to reach the ground. This specimen would thus represent the stem of *P. erianus* at a higher level than those previously found. My idea of the possible connexion of these fragments is represented in fig. 3. Mr. Lockwood's collections also contain a specimen of the large fern-petiole which I have named *Rhachiopteris punctata*. My original specimen was obtained by Prof. Hall from the same horizon in New York. That of Mr. Lockwood is of larger size, but retains no remains of the frond. It must have belonged to a species quite distinct from *Caulopteris Lockwoodi*, but which may, like it, have been a tree fern.

2. CAULOPTERIS ANTIQUA, Newberry.

(Plate XII. fig. 4.)

This is a flattened stem, on a slab of limestone, containing *Brachiopods*, *Trilobites*, &c. of the Corniferous Limestone. It is about

* The genus to which the well-known *Cyclopteris* (*Adiantites*) *hibernicus* of the Devonian of Ireland belongs.

18 inches in length, and $3\frac{1}{2}$ inches in average breadth. The exposed side shows about twenty-two large leaf-scars arranged spirally. Each leaf, where broken off, has left a rough fracture; and above this is a semicircular impression of the petiole against the stem, which, as well as the surface of the bases of the petioles, is longitudinally striated or tuberculated. The structures are not preserved, but merely the outer epidermis, as a coaly film. The stem altogether much resembles *Caulopteris Peachii*, but is of larger size. It differs from *C. Lockwoodi* in the more elongated leaf-bases, and in the leaves being more remotely placed; but it is evidently of the same general character with that species.

3. CAULOPTERIS (PROTOPTERIS) PEREGRINA, Newberry.

(Plate XII. fig. 5 and 6.)

This is a much more interesting species than the last, as belonging to a generic or subgeneric form not hitherto recognized below the Carboniferous, and having its minute structure in part preserved.

The specimens are, like the last, on slabs of marine limestone of the Corniferous formation, and flattened. One represents an upper portion of the stem with leaf-scars and remains of petioles; another a lower portion, with aerial roots. The upper part is 3 inches in diameter, and about a foot in length, and shows thirty leaf-scars, which are about $\frac{2}{3}$ of an inch wide, and rather less in depth (fig. 5, a). The upper part presents a distinct rounded and sometimes double marginal line, sometimes with a slight depression in the middle. The lower part is irregular, and when most perfect shows seven slender vascular bundles, passing obliquely downward into the stem. The more perfect leaf-bases have the structure preserved, and show a delicate, thin-walled, oval parenchyma, while the vascular bundles show scalariform vessels with short bars in several rows, in the manner of many modern ferns. Some of the scars show traces of the hippocrepian mark characteristic of *Protopteris*; and the arrangement of the vascular bundles at the base of the scars is the same as in that genus, as are also the general form and arrangement of the scars. On careful examination, the species is indeed very near to the typical *P. Sternbergii*, as figured by Corda and Schimper*.

The genus *Protopteris* of Sternberg, though the original species (*P. punctata*) appears as a *Lepidodendron* in his earlier plate (pl. 4), and as a *Sigillaria* (*S. punctata*) in Brongniart's great work, is a true tree fern; and the structure of one species (*P. Cottai*) has been beautifully figured by Corda. The species hitherto described are from the Carboniferous and Permian.

The second specimen of this species represents a lower part of the stem (fig. 6). It is 13 inches long and about 4 inches in diameter, and is covered with a mass of flattened aerial roots lying parallel to each other, in the manner of the Psaronites of the Coal-formation and of *P. erianus* of the Upper Erian or Devonian.

* Corda, Beiträge, pl. 48, copied by Schimper, pl. 52.

4. RHACHIOPTERIS, n. sp.

(Plate XII. fig. 7.)

Along with the above, in Dr. Newberry's collection, is a singular fragment enclosed in a large nodule of chert from the Corniferous Limestone. It shows clearly about 8 inches of the base of an immense petiole, from 4 to 2 inches in breadth, and attached to shreds of tissue, which seem to represent a part of the stem torn away with it. Its structure is preserved, and consists of delicate large-celled parenchyma, with slender bundles of vessels, about eighteen of which are visible. In structure they are very similar to those of the last species; but the scalariform vessels are accompanied by more woody tissue. They are parallel in the distal end of the fragment, but near its base become tortuous and branching. In the part which represents the stem, or possibly part of its roots, they assume the form of cylindrical rods of parenchyma with a central bundle of vessels. In form and outward marking it resembles *R. gigantea* of my Royal-Society Memoir; but in the latter the structure is not preserved. The present specimen must have belonged to a tree fern of grander proportions than either of those previously noticed.

In the cellular tissue of some parts of this great petiole there are numerous round granules, resembling those figured by Corda in his description of *Protopteris Cottai**, and supposed by that writer to be grains of fossilized starch. Mr. Carruthers has more recently described similar starch-granules in the tissues of an Eocene fern†. Whether the granules in the cells of the present specimen are really remains of starch, or merely rounded siliceous concretions, such as are often found in the cells of silicified plants, I am by no means certain. Perhaps the fact that similar round grains are seen in the interior of some of the woody fibres militates against their organic character. They are certainly not markings on the cell-walls, but spherical bodies contained within the cells; and if starch-grains, they may claim to be the oldest known, being of Middle Devonian age.

5. NÆGGERATHIA GILBOENSIS, n. sp.

(Plate XII. fig. 8.)

Leaf rhombic-obovate, with a broad base. Nerves or radiating plicæ nine in number, not forked, and with fine striæ between them. Length $3\frac{2}{3}$ inches. Breadth $2\frac{1}{2}$ inches.

This leaf occurs in the collections of Mr. Lockwood, from Gilboa. It belongs, without doubt, to the provisional genus *Næggarathia*, and seems to have been bent in a conduplicate manner, and clasping or decurrent, on a stem or branch. It does not seem to have been a fern; but beyond this I am not inclined to hazard any opinion as to its affinities.

* Beiträge, pl. 49.

† Quart. Journ. Geol. Soc. Aug. 1870.

In addition to this species and the *Caulopteris* above described, Mr. Lockwood's collection contains branchlets of a *Lepidodendron*, apparently *L. gaspianum*, which also occurs in Prof. Newberry's collections from the Corniferous Limestone.

6. LYCOPODITES, &c.

In his recently published 'Paléontologie,' Schimper (evidently from inattention to the descriptions and want of access to specimens) doubts the Lycopodiaceous character of the species of this genus described in my papers in the Journal of this Society from the Devonian of America. Of these *L. Richardsoni* and *L. Matthewi* are undoubtedly very near to the modern genus *Lycopodium*. *L. Vanuxemii* is, I admit, more problematical; but Schimper could scarcely have supposed it to be a fern or a fucoid allied to *Caulerpa* had he noticed that both in my species and the allied *L. pinnaeformis* of Goeppert, which he does not appear to notice, the pinnules are articulated upon the stem, and leave scars where they have fallen off. When in Belfast last summer I was much interested at finding in Prof. Thomson's collection a specimen from Caithness, which shows a plant apparently of this kind, with the same long narrow pinnæ or leaflets, attached, however, to thicker stems, and rolled up in a circinate manner. It seems to be a plant in veneration, and the parts are too much crowded and pressed together to admit of being figured or accurately described; but I think I can scarcely be deceived as to its true nature. The circinate arrangement in this case would favour a relationship to ferns; but some Lycopodiaceous plants also roll themselves in this way, and so do the branches of the plants of the genus *Psilophyton*.

In conclusion, I may state that, when in Edinburgh last summer, Mr. Peach showed me fine and characteristic specimens of rhizomata of *Psilophyton* from the Caithness beds, and also specimens which seem to show that some at least of the fragments from these beds, which have been referred to *Lepidodendron nothum*, belong to a different species, more nearly allied to the *Cyclostigma* of Killercan and Gaspé. Mr. Peach has also branches of a *Lepidodendron* like *L. gaspianum*, a *Cyclopteris* allied to *C. Brownii*, a plant of the nature of *Anarthrocampa* or *Calamites*, a *Stigmaria*, and fragments which may belong to *Sigillaria*, all from the Devonian beds of Caithness.

EXPLANATION OF PLATE XII.

- Fig. 1. *Caulopteris Lockwoodi*, one-fourth natural size, portion of stem with petioles.
 Fig. 2. Leaf-scar, natural size.
 Fig. 3. Restoration in part of *Caulopteris Lockwoodi*, reduced: *a*, upper part, with petioles; *b*, remains of pinnæ; *c*, middle part, with diverging aerial roots; *d*, lower part, with aerial roots, perhaps the same with *Psaronius erianus*, Dawson, MS.
 Fig. 4. *Caulopteris antiqua*, Newberry, one-fourth the natural size.

Fig. 5. *Protopteris peregrina*, Newberry, impression of stem, one-fourth the natural size: *xx*, remains of petioles. *5a*, scar, natural size, showing bundles of vessels at base; *5b*, portion of a vascular bundle, magnified, showing scalariform vessels and cellular tissue; *5c*, scalariform vessel, highly magnified.

Fig. 6. Lower part of stem of the same, with aerial roots, one fourth the natural size. *6a*, one of the roots, natural size.

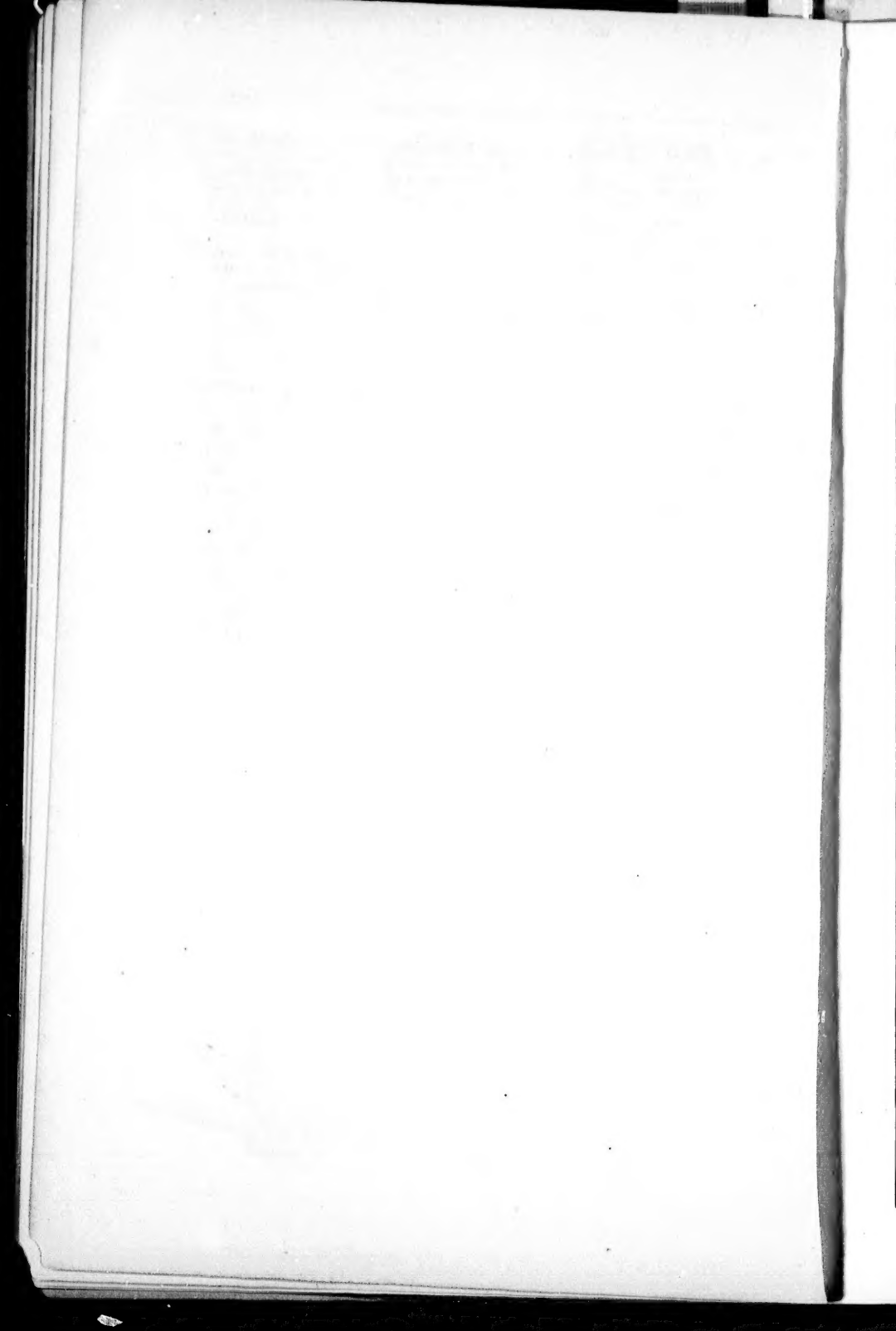
Fig. 7. Vascular bundle of *Rachiopteris*, natural size; *7a*, portion of the same, showing vascular and cellular tissue, with rounded granules in the cells; *7b*, one of the cells magnified, showing contained granules.

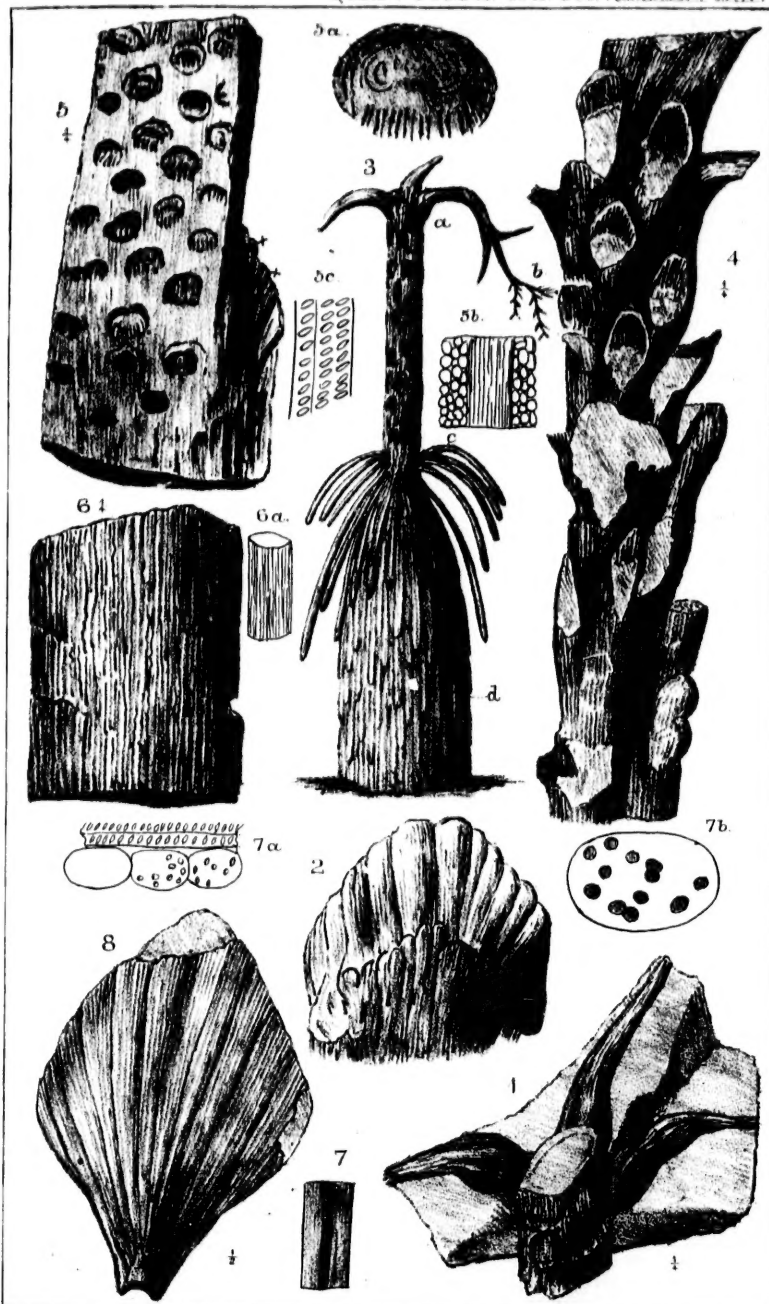
Fig. 8. *Neggerathia gilboensis*, one-half the natural size.

DISCUSSION.

Dr. DUNCAN doubted the desirability of basing generic and specific terms on imperfectly preserved and indistinct specimens, and pointed out the disagreements among botanists that had resulted from so doing. He would prefer calling fossils such as those described "cryptogamous forms from certain strata." He was doubtful also whether the supposed petrified starch was not merely orbicular silex.

The CHAIRMAN (Prof. Morris) remarked on the four different conditions exhibited by existing tree ferns:—first, with roots running down the stem; secondly, the lower portion with oval scars; these are, thirdly, further up the stem, rhomboidal vertically; and, fourthly, higher up still, rhomboidal horizontally; so that were the plant fossil, distinct genera and species might be founded upon the different parts.





R. Minter lith.

Minter Bro^s imp

DEVONIAN TREE FERNS & NEGGERATHIA.